

AMENDMENTS TO THE CLAIMS:

This listing of claims will replace all prior versions and listings of claims in the application:

1-20. (Canceled)

21. (Currently Amended) A data reproducing apparatus for reproducing data recorded by a recording equipment for recording data on a recording medium, the recording equipment including modulation encoding means for applying predetermined modulation encoding to input data, the input data having a bit sequence, wherein said modulation encoding means encodes the input data in accordance with a constraint condition by block modulation, and first interleaving means for interleaving data supplied from said modulation encoding means for re-arraying ~~the a~~ a data sequence corresponding to said data supplied from said modulation encoding means, said data reproduction apparatus comprising: ~~[[;]]~~

deinterleaving means for ~~interleaving~~ deinterleaving reproduced data in ~~[[its]]~~ a sequence such as to restore the data sequence ~~of data bits re-arrayed by said first interleaving means to the bit sequence of the data as encoded by said modulation encoding means;~~

modulation decoding means for modulation decoding ~~[[the]]~~ data supplied from said deinterleaving means in conformance with said constraint condition, wherein said modulation decoding means includes likelihood calculating means for calculating a

likelihood value corresponding to output codewords output by said modulation encoding means, wherein posterior probability information as a soft decision value for an input bit to said modulation encoding means and an output bit from said modulation encoding means is calculated using said likelihood value as calculated by said likelihood calculating means; and

second interleaving means for interleaving difference data corresponding to a difference between data output by said modulation decoding means and data output by said deinterleaving means, based on the same interleaving position information as that of said first interleaving means, for re-arraying the sequence of the difference data.

22. (Currently Amended) The data reproducing apparatus according to claim 21, wherein said modulation decoding means is fed with a soft input signal and outputs a soft output signal.

23. (Currently Amended) The data reproducing apparatus according to claim 21, wherein said recording equipment includes precode means for filtering data supplied from said first interleaving means to compensate for channel characteristics, and the data reproducing apparatus further comprising:

channel decoding means for decoding ~~[[the]]~~ a channel response.

24. (Currently Amended) The data reproducing apparatus according to claim 23, wherein said channel decoding means is fed with a soft input signal and ~~effects~~ performs soft output decoding.

25. (Currently Amended) The data reproducing apparatus according to claim 23, wherein said channel decoding means is fed with a soft input signal and ~~effects~~ performs soft output decoding based on a trellis corresponding to the channel response.

26. (Currently Amended) The data reproducing apparatus according to claim 24, wherein said deinterleaving means interleaves data corresponding to a difference between ~~[[the]]~~ data output by said channel decoding means and data output from said second interleaving means; and

wherein said modulation decoding being is iteratively performed between said modulation decoding means and said channel decoding means.

27. (Currently Amended) The data reproducing apparatus according to claim 26, wherein said recording equipment includes error correction encoding means for error correction encoding input data to supply ~~the resulting data~~ resulting from the error correction encoding to said modulation encoding means, and the data reproducing apparatus further ~~comprising;~~ comprises:

error correcting soft decoding means for soft decoding ~~[[the]]~~ an error correction code of the soft input signal corresponding to soft output data obtained by said modulation decoding means as a result of iterative decoding.

28. (Canceled)

29. (Currently Amended) The data reproducing apparatus according to claim ~~[[28]]~~ 21, wherein said first interleaving means interleaves data encoded by said modulation encoding means.

30-31. (Canceled)

32. (Currently Amended) The data reproducing apparatus according to claim ~~[[30]]~~ 21, wherein said modulation decoding means ~~effects~~ performs decoding based on a trellis corresponding to said constraint condition.

33. (Currently Amended) The data reproducing apparatus according to claim ~~[[30]]~~ 21, wherein said first interleaving means interleaves data encoded with block modulation by said modulation encoding means in terms of a modulation encoding block as a unit.

34. (Currently Amended) The data reproducing apparatus according to claim ~~[[28]]~~ 21, wherein said modulation encoding means encodes input data in accordance with said trellis conforming to said constraint condition; and
said modulation decoding means ~~effecting~~ performs decoding based on a trellis conforming to said constraint condition.

35. (Currently Amended) The data reproducing apparatus according to claim 34, wherein said first interleaving means interleaves data encoded by said modulation encoding means in terms of a modulation encoding block of said trellis as a unit.

36. (Currently Amended) The data reproducing apparatus according to claim 22, wherein said modulation decoding means ~~effects~~ performs soft output decoding based on the BCJR algorithm or on the SOVA algorithm.

37. (Currently Amended) The data reproducing apparatus according to claim 21, wherein data is recorded on said recording medium by a magnetic, optical or magneto-optical system.

38. (Currently Amended) A data reproducing method for reproducing data recorded by a recording method for recording data on a recording medium including a modulation encoding step of applying predetermined modulation encoding to input data having a bit sequence, encoding the input data in accordance with a constraint condition using block modulation, and a first interleaving step of interleaving data encoded in said modulation encoding step, for re-arraying ~~[[the]]~~ a data sequence corresponding to said data encoded in said modulation encoding step, said data reproduction method comprising the steps of:

deinterleaving the input data in ~~[[its]]~~ a sequence such as to restore the data
~~sequence of data bits re-arrayed by said first interleaving step to the bit sequence of the~~
~~data as encoded by said modulation encoding step;~~

modulation decoding ~~[[the]]~~ data supplied from said step of deinterleaving, in
conformance with said constraint condition, wherein the step of modulation decoding
further includes a likelihood calculating step of calculating a likelihood value of output
codewords generated and output by said modulation encoding step;

calculating posterior probability information as a soft decision value for an input
bit to said modulation encoding step and an output bit from said modulation encoding
step using said likelihood value as calculated by said likelihood calculating step; and

interleaving difference data corresponding to a difference between data decoded
in said modulation encoding step and data re-arrayed in said step of deinterleaving,

based on the same interleaving position information as that of said first interleaving step, for re-arraying the sequence of the difference data.

39. (Currently Amended) The data reproducing method according to claim 38, wherein said step of modulation decoding is fed with a soft input signal and outputs a soft output signal.

40. (Currently Amended) The data reproducing method according to claim 38, wherein said recording method includes a precode step of filtering data supplied from said first interleaving step to compensate for channel characteristics, and the data reproducing method further comprising:

channel decoding ~~[[the]]~~ a channel response.

41. (Currently Amended) The data reproducing method according to claim 40, wherein said step of channel decoding is fed with a soft input signal and ~~effects~~ performs soft output decoding.

42. (Currently Amended) The data reproducing method according to claim 40, wherein said step of channel decoding is fed with a soft input signal and ~~effects~~ performs soft output decoding based on a trellis corresponding to the channel response.

43. (Currently Amended) The data reproducing method according to claim 41, wherein said step of deinterleaving interleaves data corresponding to a difference between ~~[[the]]~~ data decoded in said step of channel decoding and data re-arrayed in said step of interleaving;

~~decoding being iteratively performed~~ performing decoding between said step of modulation decoding and said step of channel decoding.

44. (Currently Amended) The data reproducing method according to claim 43, wherein said recording method includes an error correction encoding step of error correction encoding input data to supply ~~the resulting data~~ resulting from the error correction encoding to said modulation encoding step, and the data reproducing method further comprising:

soft decoding ~~[[the]]~~ an error correction code of the soft input signal corresponding to soft output data obtained by said modulation decoding step as a result of iterative decoding.

45. (Canceled)

46. (Currently Amended) The data reproducing method according to claim ~~[[45]]~~ 38, wherein said first interleaving step interleaves data encoded by said modulation encoding step so that the constraint condition is satisfied.

47-48. (Canceled)

49. (Currently Amended) The data reproducing method according to claim ~~[[47]]~~ 38, wherein said modulation decoding step ~~effects~~ performs decoding based on a trellis corresponding to said constraint condition.

50. (Currently Amended) The data reproducing method according to claim ~~[[47]]~~ 38, wherein said first interleaving step interleaves data encoded with block modulation by said modulation encoding step in terms of a modulation encoding block as a unit.

51. (Currently Amended) The data reproducing method according to claim ~~[[45]]~~ 38, wherein said modulation encoding step encodes input data in accordance with the trellis conforming to said constraint condition; and
said step of modulation decoding ~~effects~~ performs decoding based on a trellis conforming to said constraint condition.

52. (Currently Amended) The data reproducing method according to claim 51, wherein said first interleaving step interleaves data encoded by said modulation encoding step in terms of a modulation encoding block of said trellis as a unit.

53. (Currently Amended) The data reproducing method according to claim 39, wherein said step of modulation decoding ~~effects~~ performs soft output decoding based on the BCJR algorithm or on the SOVA algorithm.

54. (Currently Amended) The data reproducing method according to claim 38, wherein data is recorded on said recording medium by a magnetic, optical or magneto-optical system.

55. (Currently Amended) A data recording and reproducing apparatus for recording and reproducing data for a recording medium, said apparatus comprising:
modulation encoding means for applying predetermined modulation encoding to input data having a bit sequence, wherein said modulation encoding means encodes the input data in accordance with a constraint condition by block modulation;

first interleaving means for interleaving data supplied from said modulation encoding means for re-arraying ~~the~~ a data sequence corresponding to said data supplied from said modulation encoding means;

deinterleaving means for ~~interleaving~~ deinterleaving reproduced data in ~~[[its]]~~ a sequence such as to restore the data sequence of data bits re-arrayed by said first interleaving means to the bit sequence of the data as encoded by said modulation encoding means;

modulation decoding means for modulation decoding ~~[[the]]~~ data supplied from said deinterleaving means in conformance with said constraint condition, wherein said modulation decoding means further includes:

likelihood calculating means for calculating a likelihood value corresponding to output codewords output by said modulation encoding means, wherein posterior probability information as a soft decision value for an input bit to said modulation encoding means and an output bit from said modulation encoding means is calculated using said likelihood value as calculated by said likelihood calculating means; and

second interleaving means for interleaving difference data corresponding to a difference between data output by said modulation decoding means and data output by said deinterleaving means, based on the same interleaving position information as that of said first interleaving means, for re-arraying the sequence of the difference data.

56. (Currently Amended) The data recording and reproducing apparatus according to claim 55, wherein said modulation decoding means is fed with a soft input signal and outputs a soft output signal.

57. (Currently Amended) The data recording and reproducing apparatus according to claim 55, further comprising:

precode means for filtering data supplied from said first interleaving means to compensate for channel characteristics, and

channel decoding means for decoding ~~[[the]]~~ a channel response.

58. (Currently Amended) The data recording and reproducing apparatus according to claim 57, wherein said channel decoding means is fed with a soft input signal and ~~effects~~ performs soft output decoding.

59. (Currently Amended) The data recording and reproducing apparatus according to claim 57, wherein said channel decoding means is fed with a soft input signal and ~~effects~~ performs soft output decoding based on a trellis corresponding to the channel response.

60. (Currently Amended) The data recording and reproducing apparatus according to claim 58, wherein said deinterleaving means interleaves data corresponding to difference between the data output by said channel decoding means and data output from said second interleaving means; and
wherein said modulation decoding ~~being~~ is iteratively performed between said modulation decoding means and said channel decoding means.

61. (Currently Amended) The data recording and reproducing apparatus according to claim 60, further comprising:

error correction encoding means for error correction encoding input data, wherein said modulation encoding means modulation encodes data supplied from said error correction encoding means; and

error correcting soft decoding means for soft decoding ~~[[the]]~~ an error correction code of the soft input signal corresponding to the soft output data obtained by said modulation decoding means as a result of iterative decoding.

62. (Canceled)

63. (Currently Amended) The data recording and reproducing apparatus according to claim ~~[[62]]~~ 55, wherein said first interleaving means interleaves data encoded by said modulation encoding means.

64-65. (Canceled)

66. (Currently Amended) The data recording and reproducing apparatus according to claim ~~[[64]]~~ 55, wherein said modulation decoding means ~~effects~~ performs decoding based on a trellis corresponding to said constraint condition.

67. (Currently Amended) The data recording and reproducing apparatus according to claim ~~[[64]]~~ 55, wherein said first interleaving means interleaves data encoded with block modulation by said modulation encoding means in terms of a modulation encoding block as a unit.

68. (Currently Amended) The data recording and reproducing apparatus according to claim ~~[[62]]~~ 55, wherein said modulation encoding means encodes input data in accordance with said trellis conforming to said constraint condition; and said modulation decoding means ~~effects~~ performs decoding based on a trellis conforming to said constraint condition.

69. (Currently Amended) The data recording and reproducing apparatus according to claim 68, wherein said first interleaving means interleaves data encoded by said modulation encoding means in terms of a modulation encoding block of said trellis as a unit.

70. (Currently Amended) The data recording and reproducing apparatus according to claim 56, wherein said modulation decoding means ~~effects~~ performs soft output decoding based on the BCJR algorithm or on the SOVA algorithm.

71. (Currently Amended) The data recording and reproducing apparatus according to claim 55, wherein data is recorded on said recording medium by a magnetic, optical or magneto-optical system.

72. (Currently Amended) A data recording and reproducing method for recording and reproducing data for a recording medium, said method comprising the steps of:

applying predetermined modulation encoding to input data having a bit sequence, wherein said modulation encoding encodes the input data in accordance with a constraint condition by block modulation;

interleaving the modulation-encoded data for re-arraying ~~[[the]]~~ a data sequence corresponding to the modulation-encoded data;

deinterleaving reproduced data in ~~[[its]]~~ a sequence such as to restore the data sequence of data bits re-arrayed by said step of interleaving to the bit sequence of the modulation-encoded data;

modulation decoding the data supplied from said step of deinterleaving in accordance with said constraint condition, wherein said step of modulation decoding further includes a likelihood calculating step for calculating a likelihood value corresponding to each output codeword output by said modulation encoding step;

calculating posterior probability information as a soft decision value for an input bit to said step of applying and an output bit from said step of applying using said likelihood value as calculated by said likelihood calculating step; and

interleaving difference data corresponding to a difference between data decoded in said step of modulation decoding and data re-arrayed in said step of deinterleaving based on the same interleaving position information as that of said step of interleaving the modulation-encoded data.

73. (Currently Amended) The data recording and reproducing method according to claim 72, wherein said step of modulation decoding is fed with a soft input signal and outputs a soft output signal.

74. (Currently Amended) The data recording and reproducing method according to claim 72, further comprising:
filtering data supplied from said step of interleaving the modulation-encoded data to compensate for channel characteristics, and
channel decoding ~~[[the]]~~ a channel response.

75. (Currently Amended) The data recording and reproducing method according to claim 74, wherein said step of channel decoding is fed with a soft input signal and ~~effects~~ performs soft output decoding.

76. (Currently Amended) The data recording and reproducing method according to claim 74, wherein said step of channel decoding is fed with a soft input signal and ~~effects~~ performs soft output decoding based on a trellis corresponding to the channel response.

77. (Currently Amended) The data recording and reproducing method according to claim 76, wherein said step of deinterleaving interleaves data corresponding to data between ~~[[the]]~~ data output by said step of channel decoding and data output from said step of interleaving the difference data; and
~~decoding being iteratively performed~~ performs decoding between said step of modulation decoding and said step of channel decoding.

78. (Currently Amended) The data recording and reproducing method according to claim 77, further comprising:
error correction encoding input data, wherein said step of applying modulation encodes data supplied from said step of error correction encoding; and
soft decoding ~~[[the]]~~ an error correction code of the soft input signal corresponding to ~~[[the]]~~ soft output data obtained by said step of modulation decoding as a result of iterative decoding.

79. (Canceled)

80. (Currently Amended) The data recording and reproducing method according to claim 79, wherein said step of interleaving the modulation-encoded data interleaves the modulation-encoded data so that the constraint condition is satisfied.

81-82. (Canceled)

83. (Currently Amended) The data recording and reproducing method according to claim ~~[[81]]~~ 72, wherein said step of modulation decoding ~~effects~~ performs decoding based on a trellis corresponding to said constraint condition.

84. (Currently Amended) The data recording and reproducing method according to claim ~~[[81]]~~ 72, wherein said step of interleaving the modulation-encoded data interleaves the modulation-encoded data in terms of a modulation encoding block as a unit.

85. (Currently Amended) The data recording and reproducing method according to claim ~~[[79]]~~ 72, wherein said step of applying modulation encodes input data in accordance with the trellis conforming to said constraint condition; and
said step of modulation decoding ~~effects~~ performs decoding based on a trellis conforming to said constraint condition.

86. (Currently Amended) The data recording and reproducing method according to claim 85, wherein said step of interleaving the modulation-encoded data interleaves the modulation-encoded data in terms of a modulation encoding block of said trellis as a unit.

87. (Currently Amended) The data recording and reproducing method according to claim 73, wherein said modulation decoding step ~~effects~~ performs soft output decoding based on the BCJR algorithm or on the SOVA algorithm.

88. (Currently Amended) The data recording and reproducing method according to claim 72, wherein data is recorded on said recording medium by a magnetic, optical or magneto-optical system.